



Jet Propulsion Laboratory

Cartography and Imaging  
Sciences Node

U.S. Geological Survey

# The NASA Planetary Data System's Cartography and Imaging Sciences Node and the Planetary Spatial Data Infrastructure (PSDI) Initiative

**Lisa Gaddis**  
**PDS-IMG Node PI**  
**USGS, Astrogeology**

# Overview



- ◎ **What is PDS?**
  - **PDS Charter and Requirements**
  - **PDS4**
  - **PDS Discipline Node Organization**
    - **Cartography and Imaging Sciences (IMG)**  
**examples of data, tools & services**
- ◎ **How does PDS fit into the PSDI initiative?**

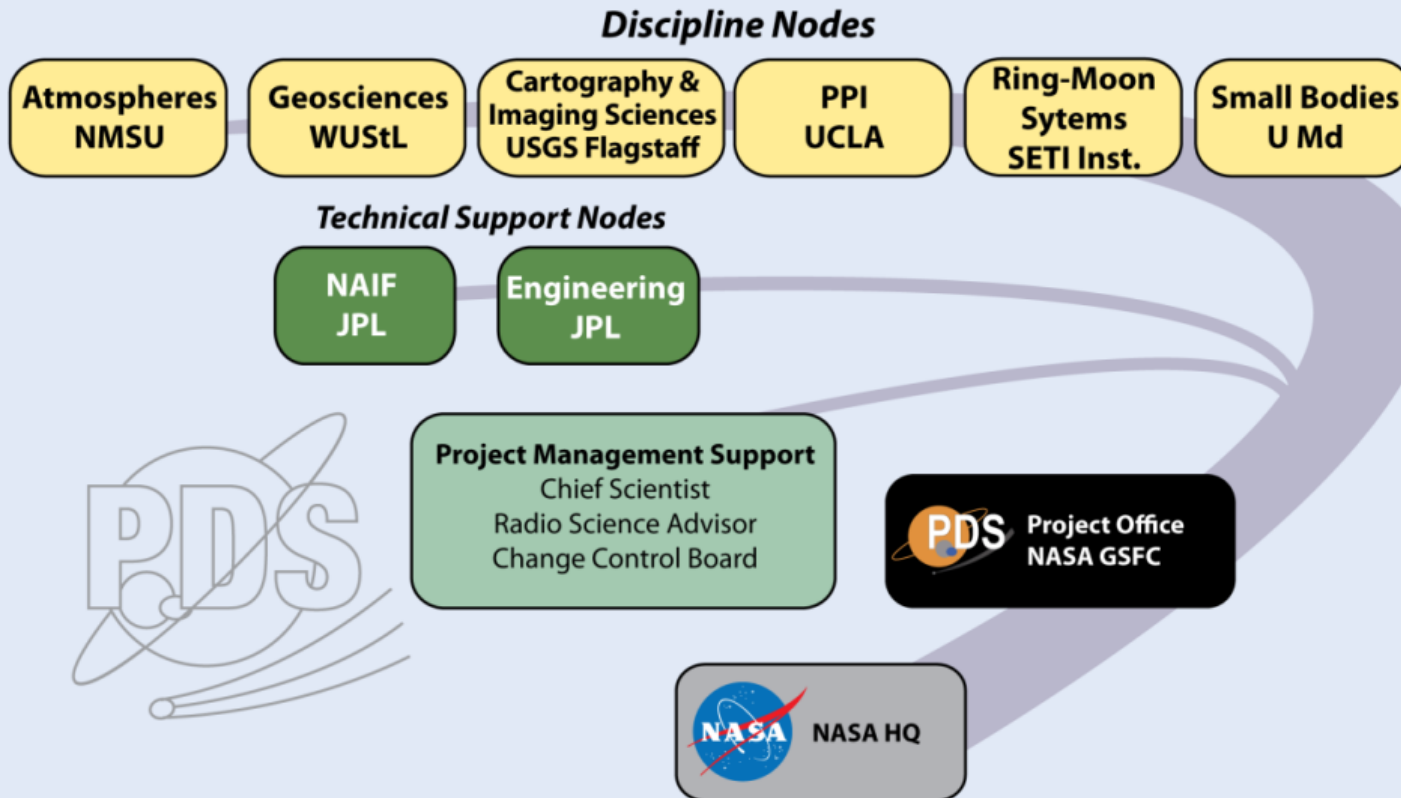
# What is PDS?

- ⦿ The NASA Planetary Data System is a **federation** of distributed **science discipline** and support nodes
  - Six science, two support; project management & support
- ⦿ The PDS **Charter**
  - Efficiently collect, archive, and make accessible digital data produced by or relevant to NASA missions, research programs, and data analysis programs
- ⦿ PDS formal **Requirements**
  - Provide **expertise** to help NASA missions and other data providers to organize and document their digital planetary data
  - Collect and maintain **archives** with complete, well-documented, peer-reviewed planetary data
  - Make planetary data **accessible** to the science community
    - Provide online data delivery tools & search services, etc.
  - Ensure the long-term **preservation** and **usability** of the data

- **The new PDS**, an integrated data system to improve access
  - Required for all missions (e.g., used by LADEE, MAVEN) and small data archives (since 2011)
- A re-architected, modern, online data system
- Improves efficiency of both ingestion and distribution of data
  - Uses Extensible Markup Language (XML) and standard data format templates
  - Self-consistent information model & software system
- Supports explicit referencing of related material
  - Products can point to the exact (file and version) calibration parameters that were used
    - For example, Europa MAG data can reference PIMS and S/C trajectory data at the collection or bundle level
  - BUT, these internal or external references are optional in the data model
    - **The power they provide is only available if they are included**

# What is PDS?

## Current Organization of the Planetary Data System



See also: <https://pds.nasa.gov/about/organization.shtml>

# PDS Discipline Nodes



- The **science discipline** focus ensures that **data experts** can guide identification and use of data for their discipline
- Each discipline node supports archival and delivery of “their” data
  - Widespread geographic data searches are relatively recent (~10 years)
    - MAP/MAP2, Atlas, PILOT, Orbital Data Explorers, etc.
  - Some discipline lines are blurry
    - “Imaging” (IMG) node does not archive all images in PDS
    - Both GEO and IMG archive DEMs/DTMs
  - **Mission** and **Target Body** searches are more complicated
    - **Cassini data** are found at ATM, IMG, PPI, RMS, SBN, EN, NAIF
    - **Mars** data are at all nodes



# PDS Cartography & Imaging Sciences (IMG) Discipline Node



- Curator of NASA's larger digital image collections from planetary missions
  - ~900 TB, growing ~100 TB/yr
- Develops & supports archive standards for
  - Image data formats, shapefiles, etc.
  - Documentation of observation and acquisition parameters, image properties, etc. (metadata)
  - Image calibration, documentation
- Supports validation, delivery of digital image archives, ancillary & supporting information
  - Landed and orbital cameras and imagers, metadata
  - Cartographic products such as mosaics, maps, shapefiles, geospatial databases, etc.
  - Links to heritage, publications, figures, etc.
- Leverages USGS/ISIS software to serve processed, derived data products on demand
  - **When ISIS is used**, supports mission pipeline processing in perpetuity
    - From raw to calibrated, photometrically corrected, map-projected products



<http://img.pds.nasa.gov/>

# IMG Science Discipline Focus



## ◉ Interdisciplinary expertise

- Instrument/image geometry, cartographic data acquisition & processing
- Orbital & landed camera instrument design, data processing & calibration
  - Detailed geometric & physical characterization of cameras
- Planetary remote sensing at UV to VIS to IR to thermal IR to radar wavelengths
  - Single band, multi-band and hyperspectral images
- Cartographic & geospatial data analysis
  - Geographic information systems, geologic & thematic mapping, 3D terrain mapping & analysis, slope & hazard mapping, site characterization
- Data engineering & informatics, data mining

## ◉ Serves data for a variety of planetary bodies

- Terrestrial planetary surfaces
  - Mercury, Venus, Earth, Moon, Mars, Mars' moons Phobos and Deimos, asteroids Gaspra, Ida
- Icy and outer Solar System satellites, dwarf planets, asteroids
  - 9 moons of Jupiter (Io, Europa, Ganymede, Callisto, etc.)
  - 23 moons of Saturn (Titan, Enceladus, Iapetus, etc.)
  - 2 moons of Neptune (Triton, Nereid)
  - 5 moons of Uranus (Ariel, Titania, etc.)
  - Vesta; Ceres; Pluto (TBD)



# IMG Primary Duties for PDS



- **Mission Interface**

- Work with imaging instrument teams to ensure cost-effective data delivery to PDS and public
- Apply systems engineering principles to data to ensure rapid identification, easy access & download of PDS data

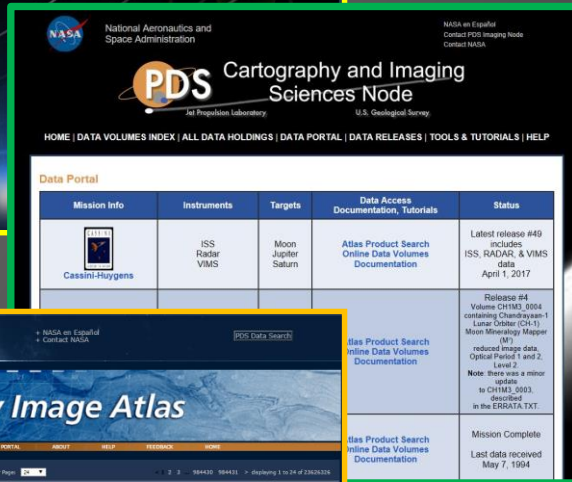
- **Data Delivery & Cartographic Support**

- Support delivery of planetary image data in raw & derived formats
- Deliver improved ancillary data (pointing, calibration) resulting from radiometric, geodetic & cartographic processing, restoration, scientific research, etc.

- **Data User Support**

- Maintain and support online data, provide search & access tools
- Provide sophisticated tools & instructions for simple to complex data interaction by users
- Provide training, expert assistance to users for cartographic and scientific data analysis (LPSC, Planetary Data Users workshops, etc.)

# IMG Data Delivery Systems (1 of 2)



## Photojournal

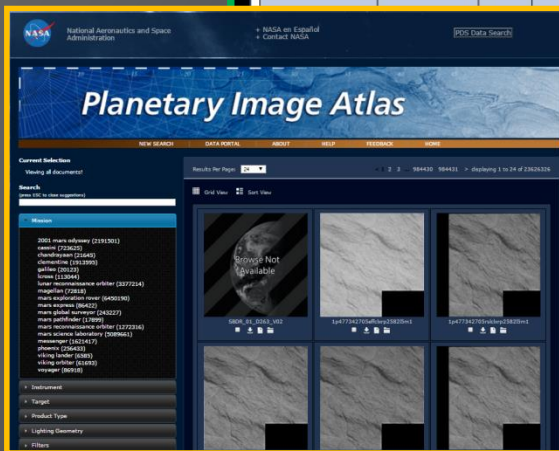
- Press-release images, other quick-release “pretty pictures”
- <http://photojournal.jpl.nasa.gov/>

## Data Portal

- Image data, sorted by mission name
- Links to mission documentation
- <http://pds-imaging.jpl.nasa.gov/portal/>

## Planetary Image Atlas

- Faceted searches based on image label data, geographic coordinates, etc.
- Products linked to IAU planetary nomenclature database
- Supports landmark feature classification and searches
- <http://pds-imaging.jpl.nasa.gov/search/>



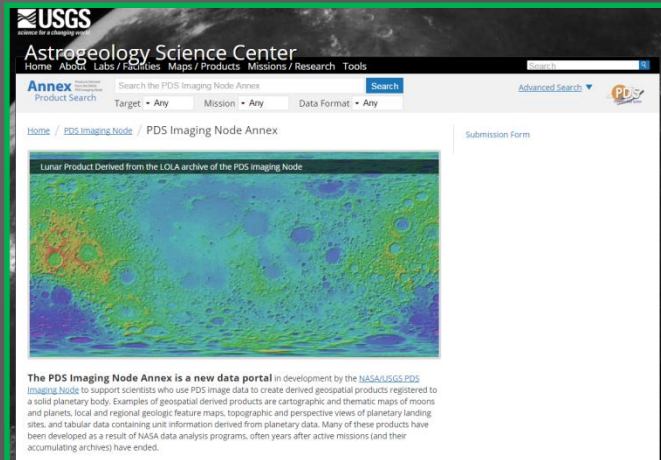
<http://img.pds.nasa.gov/>

# IMG Data Delivery Systems (2 of 2)



## ● Map-a-Planet (MAP) 2

- Delivers map-projected mosaics & derived data
- Basemaps for EDR searches at IMG, GEO
- Standardized Web Mapping Services (WMS) for ~all mapped bodies
- Supports map-based selection and processing of data products
- <http://astrogeology.usgs.gov/tools/map>



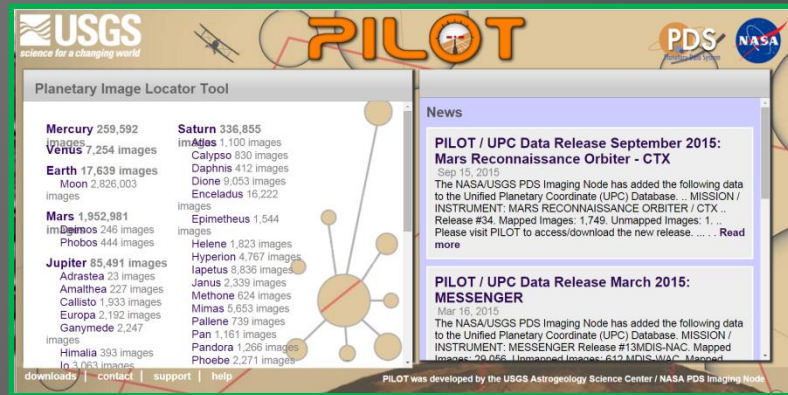
## ● Imaging Node Annex

- Delivers geospatial products derived from PDS data
  - Mosaics, maps, shapefiles, databases
- Retains heritage to source data & metadata
- Links to publications, accuracy information, etc.
- <http://astrogeology.usgs.gov/pds/annex>

<http://img.pds.nasa.gov/>

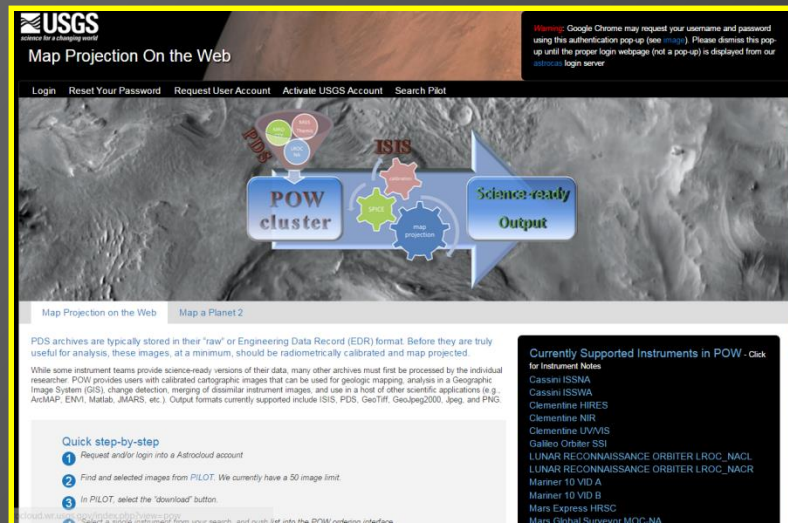


# IMG Data Processing Systems



## ● Planetary Image Locator Tool (PILOT)

- Uses Unified Planetary Coordinates (UPC) database to standardize coordinates
- Supports PDS image data for which there is an ISIS3 camera model
  - Accurate, detailed surface placement
  - 94% of Imaging Node data holdings supported
- Geospatial and parameter search of PDS EDR image archives
- Ties to online POW processing tools
- <http://pilot.wr.usgs.gov/>



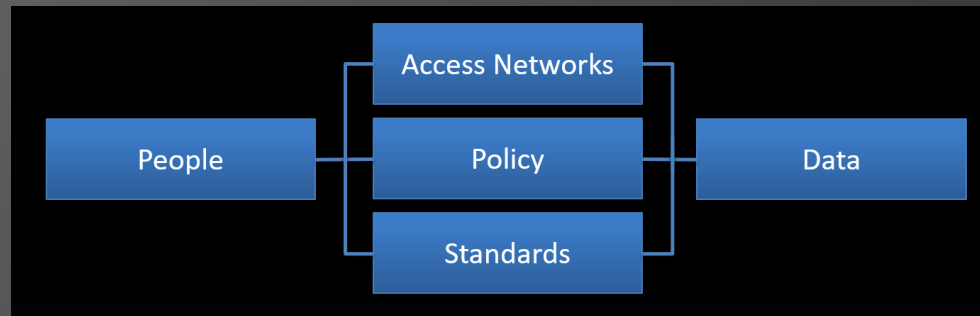
## ● Projection on the Web (POW)

- Employs ISIS3 cartographic software
- Pipeline data processing from raw to fully processed data products
- <http://astrocloud.wr.usgs.gov/>

# PDS and PSDI



- **PDS focuses on long-term data preservation and archiving**
  - Mandate for data collection, archiving, delivery with science discipline focus



- **The current PSDI initiative extends beyond data to address user needs**
  - Includes planning for products and capabilities
  - Emphasizes use of latest technologies
  - Enables “rapid” development of tailored visualization and data delivery services
  - Supports collaborative research environment, sharing of information, development of knowledge

# Summary

- PDS is an element of the PSDI initiative
- PDS complements and facilitates the development of the PSDI vision and implementation

